Real-life use of thromboprophylaxis in patients hospitalized for pulmonary disorders: A single-center retrospective study

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Abstract

Background. Underuse of thromboprophylaxis in hospitalized medical patients is still common worldwide. Little is known about the use of thromboprophylaxis in patients with pulmonary diseases in everyday hospital practice.

Objectives. The aim of this study was to assess the use of pharmacological prophylaxis of venous thromboembolism (VTE) in real-life patients with pulmonary diseases.

Material and methods. In this retrospective study, 2 validated scoring systems, i.e., the Padua prediction score and Caprini VTE risk assessment, were used to assess the VTE risk in 2011 patients (1133 men and 878 women), aged 18 years or more, hospitalized for pulmonary diseases (median 6 days) in a single tertiary pulmonary medical center from January to December 2014.

Results. Using the Padua prediction score, we identified 428 (21.28%) patients at a high risk for VTE, including 167 (39.01%) who received thromboprophylaxis with low-molecular-weight heparin, and 261 (60.98%) individuals at a high risk without thromboprophylaxis ($p < 0.001$). A total of 888 (44.16%) patients who scored 5 points or more using the Caprini VTE risk assessment were identified as subjects at a high risk for VTE, including 34.79% of patients receiving thromboprophylaxis. From among patients at a high risk for VTE, 579 (65.20%) did not receive appropriate thromboprophylaxis ($p < 0.001$). Underuse of thromboprophylaxis was observed more commonly among patients hospitalized for lung cancer or pneumonia (50.60% and 24.87% of patients at a high risk for VTE without prophylaxis, respectively).

Conclusions. Thromboprophylaxis is underutilized in hospitalized patients with pulmonary diseases regardless of the scoring system used. Implementation of thromboprophylaxis should be markedly improved in this patient group.

Key words: venous thromboembolism, thromboprophylaxis, pulmonary diseases, Padua prediction score, Caprini VTE risk assessment

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Introduction

Hospitalization is associated with an increased risk of developing venous thromboembolism (VTE) and leads to 10–20% of the VTE episodes in the general population.[1–3] Importantly, 10% of in-hospital deaths are related to VTE.[4–6] It has been estimated that 42% of hospitalized patients are at an intermediate or high risk for VTE.[1] An increased risk of VTE is also observed during the 30-day post-discharge period.[1,7]

Appropriate pharmacologic prophylaxis to prevent VTE with its consequences has been recognized as a key medical intervention among patients admitted to hospital, as it directly increases their safety, reduces the occurrence of VTE, and reduces the cost of medical treatment. Appropriate thromboprophylaxis reduces the risk of VTE by half.[8,9] Surgical patients benefit more than medical patients. The 2012 and 2016 guidelines of the American College of Chest Physicians (ACCP) strongly recommend pharmacologic prophylaxis among hospitalized patients at a high risk for VTE (grade 1B), or mechanical thromboprophylaxis in patients at a high risk for VTE as well as for bleeding, or those who bleed actively (grade 2C).[9,10] Identification of high-risk VTE patients who should receive thromboprophylaxis during the hospital stay can be done by means of validated scoring systems, which usually divide patients into high and low risk groups. The former group should receive thromboprophylaxis. The ACCP recommends the Padua prediction score,[11] a validated risk assessment model identifying patients at a high risk for VTE (4 points or more) and those at a low risk for VTE (fewer than 4 points). There is an alternative to the Padua prediction score, the Caprini VTE risk assessment, in which a high risk for VTE is defined as 5 points or more. It is important to consistently use 1 system in everyday hospital practice. The recommended thromboprophylaxis during hospitalization is heparin, most common worldwide, low-molecular-weight heparin (LMWH) s.c., or, infrequently, unfractionated heparin (UFH), or, very rarely, fondaparinux.[9,10] Neither the use of aspirin nor the use of antiplatelet agents is recommended as a prophylaxis of VTE.[9,10] The effectiveness of thromboprophylaxis was assessed in 3 large clinical trials, namely MEDENOX (the Medical Patients with Enoxaparin Trial), in which enoxaparin was used once daily;[12] PREVENT (the Prospective Evaluation of Dalteparin Efficacy for Prevention of VTE in Immobilized Patients Trial), in which dalteparin was used once daily;[13] and ARTEMIS (the Affordability and Real-World Antiplatelet Treatment Effectiveness After Myocardial Infarction Study), in which fondaparinux was used once daily.[14] Some newer oral anticoagulants, e.g., apixaban, dabigatran, and rivaroxaban, can be used as thromboprophylaxis after hospitalization due to surgical indications solely in orthopedic patients.[9,10] The optimal duration of VTE prophylaxis in medical patients is unknown. The current approach is to use it during the whole hospitalization period, and under some circumstances it might be continued for 28 days after discharge.[9,10]

Physicians who refer medical patients to hospital and then take care of them may still fail to put them on thromboprophylaxis in accordance with the ACCP guidelines. They commonly perceive some patients as low-risk individuals, especially if the planned hospital stay is short. On the other hand, there is a subset of patients with a low or moderate risk for VTE who receive pharmacologic thromboprophylaxis during hospital stay, which increases the risk of bleeding, and cost.

A particular group of medically-treated patients who often require thromboprophylaxis during hospitalization are patients with pulmonary disease. For example, the risk of VTE in chronic obstructive pulmonary disease (COPD) exacerbation ranges from 5% to even 29%.[15–18] Postmortem examination of patients who died due to COPD exacerbation have demonstrated pulmonary embolism (PE) in 28–51% of cases.[19,20] Lung cancer is a well- established potent risk factor for developing VTE.[21–25] Respiratory diseases of low prevalence are reported to be associated with an elevated VTE risk. The risk of VTE in patients with pulmonary fibrosis has been estimated as 34% higher than in the background population, and 44% and 54% greater than among patients with COPD and lung cancer, respectively.[26] Asthma is also increasingly perceived as a disease related to an increased VTE risk.[27]

The Epidemiologic International Day for the Evaluation of Patients at Risk for Venous Thromboembolism in the Acute Hospital Care Setting (ENDORSE) study was also performed in Poland and its results were published in 2007.[28,29] It was found that as few as 51.8% of high-risk patients received the thromboprophylaxis recommended by the ACCP (54.7% of surgical patients and 32.5% of nonsurgical patients). In this study, pulmonary patients constituted 26.8% of all evaluated subjects. The main cause of hospitalization was pneumonia (17.6%) and acute respiratory infections (9.2%).[29] Recently, the proportion of hospitalized, medically-treated patients with pulmonary disorders has been increasing in the aging populations; however, PE still remains the main preventable cause of death in this population.[4–6]

Objectives

To our knowledge, there have been no published reports on VTE risk in real-life patients hospitalized in pulmonology wards in recent years. Therefore, the aim of our study was to evaluate the risk of VTE among hospitalized patients and the use of thromboprophylaxis in a ward in which patients with respiratory disorders are treated. We sought to assess the current trends in thromboprophylaxis in patients hospitalized for pulmonary diseases in tertiary specialist hospitals.

Material and methods

In this retrospective study, we enrolled all the patients aged 18 years or more, hospitalized from January 1, 2014 to December 31, 2014 in the Pulmonology Ward of the John Paul II Hospital in Krakow, Poland. Solely patients who stayed in the hospital for more than 24 h were eligible. The hospitalized patients did not need intensive care. No exclusion criteria were used for patients admitted to the ward. The study was carried out in accordance with local legal regulations.

All patients were classified into one of 6 core groups based on the main cause of hospitalization identified at discharge.

Medical data, i.e., demographics, basic and concomitant diseases, duration of hospitalization, and medications, was collected on the basis of hospital records. Patients' physical activity when hospitalized, reduced mobility making a patient stay in bed for more than 30 min during 3 consecutive days as well as any non-pharmacologic thromboprophylaxis were determined on the basis of nursing care records.

We selected 2 validated scoring systems, the Padua prediction score and Caprini VTE risk assessment, and evaluated the VTE risk in all patients.[9,11] 2014 was the last year prior to the implementation of 1 recommended VTE risk assessment tool for the patients hospitalized in the ward.

The Padua prediction score was one model used to identify patients at a high risk for VTE when hospitalized. The group included patients whose score was 4 or higher. Those whose score was lower than 4 were identified as at a low risk for VTE when hospitalized. The Caprini VTE risk assessment was the other model used to identify patients at a high risk for VTE when hospitalized. Those whose score was 4 or lower were identified as not at a high risk for VTE when hospitalized. The group included those whose score was 5 or higher.

Administration of enoxaparin (40 mg once daily from the first to the last day of hospitalization) was used as thromboprophylaxis for all patients at a high risk for VTE. Mechanical thromboprophylaxis was not used.

Not using thromboprophylaxis in patients at a high risk for VTE was recognized as the underuse of prophylaxis, while the overuse of prophylaxis was recognized as using any thromboprophylaxis in patients identified as at a low risk for VTE.

Statistical analysis

The variables were presented as number and percentage. Categorical variables in the subgroups were compared by the Pearson's χ^2 test or the Fisher's exact test for 2 × 2 tables. All p-values presented were two-sided and were considered as statistically significant if below 0.05. All calculations were done with JMP® v. 12.2.0 (SAS Institute Inc., Cary, USA). The Caprini VTE risk assessment and Padua prediction score were expressed as median and interquartile range (IQR), and were compared with the Mann-Whitney U test and the Kruskal-Wallis test.

Results

A total of 2011 individuals aged between 18 and 94 (median: 66) years, including 1133 (56.4%) men and 878 (45.6%) women, were analyzed (Table 1). The mean duration of hospitalization was 6 days. The most common causes of hospitalization were pneumonia (n = 780; 38.8%) and lung cancer (n = 551; 27.4%). Eighty-seven (4.3%) patients were on anticoagulation with vitamin K antagonists (VKAs) on admission. During hospitalization, 368 (18.3%) patients received thromboprophylaxis with enoxaparin.

Padua prediction score

Using the Padua prediction score, we identified 428 (21.28%) patients at a high risk for VTE, including 167 (39.01%) who received thromboprophylaxis. As many as 60.98% of high-risk patients did not receive thromboprophylaxis (Table 2). Out of the 1583 (78.7%) patients with a low risk of VTE, 201 (9.99%) received thromboprophylaxis ($p < 0.001$) (Table 2).

Caprini VTE risk assessment

A total of 888 (44.16%) patients scored 5 points or more using the Caprini VTE risk assessment, and were identified as subjects at a high risk for VTE, including 309 (34.79%) who received thromboprophylaxis. On the other hand, 579 (65.20%) individuals who were at a high risk for VTE did not receive appropriate thromboprophylaxis (Table 3). The number of patients identified as at a low risk for VTE was 1123 (55.88%). Fifty-nine of them received thromboprophylaxis despite having no indications, which makes up 5.25% of the cohort ($p < 0.001$) (Table 3).

The main cause of hospitalization

The main causes of hospitalization among patients requiring thromboprophylaxis were diseases of airways, lung cancer, interstitial lung disease, pneumonia, and respiratory failure. A total of 138 (15.54%) patients with diseases of airways scored 5 points or more using the Caprini VTE risk assessment, and were identified as at a high risk of VTE. Ninety (15.54%) individuals were identified as underusing thromboprophylaxis (Table 3). Using the Padua prediction score with this group, 12 (4.60%) patients were demonstrated to underuse thromboprophylaxis (Table 2).

Among lung cancer patients, 293 (50.60%) individuals were identified as underusing thromboprophylaxis according to the Caprini VTE risk assessment (Table 3). Using the Padua prediction score in this group, 218 (83.52%) patients were demonstrated to underuse thromboprophylaxis (Table 2).

According to the Caprini VTE risk assessment, 38 (6.56%) of the interstitial lung disease patients were also underusing thromboprophylaxis (Table 3). Using the Padua prediction score with these patients, 3 (1.15%) individuals

Table 1. Characteristics of the study cohort

Characteristics	The whole population n = 2011	Patients who received thromboprophylaxis n = 368 (18.3%)	Patients who did not receive thromboprophylaxis n = 1643 (81.7%)	p-value
Age > 70 years	632 (31.4)	177 (8.8)	455 (22.6)	<0.001
Men	1133 (56.4)	213 (10.6)	920 (45.7)	0.52
BMI > 30 kg/m^2	349 (17.3)	77 (3.8)	272 (13.5)	0.05
Acute patients	124 (6.2)	13 (0.6)	111 (5.5)	0.02
Elective patients	1887 (93.8)	355 (17.6)	1532 (76.2)	0.02
Cause of hospitalization				
Airways diseases[1]	332 (16.5)	65 (3.2)	267 (13.3)	<0.001
Interstitial lung disease[2]	268 (13.3)	11 (0.5)	257 (12.8)	<0.001
Lung cancer	551 (27.4)	160 (7.9)	391 (19.4)	<0.001
Pneumonia	780 (38.8)	77 (10.5)	703 (34.9)	<0.001
Pulmonary embolism	52 (2.6)	46 (2.3)	6 (0.3)	<0.001
Respiratory failure	28 (1.4)	9 (0.4)	19 (0.9)	<0.001
Comorbidities				
Arrhythmia	79 (3.9)	63 (3.1)	16 (0.8)	<0.001
Diabetes	127 (6.3)	27 (1.3)	100 (5.0)	0.41
Arterial hypertension	859 (42.7)	215 (10.7)	644 (32.0)	<0.001
Heart failure	14 (0.7)	10 (0.5)	4 (0.2)	<0.001
Thyroid disorders	35 (1.7)	3 (0.1)	32 (1.6)	0.18
Previous venous thromboembolism	13 (0.6)	9 (0.4)	4 (0.1)	<0.001
Varicose veins	164 (8.2)	68 (3.4)	96 (4.8)	<0.001
Other diseases	44 (2.2)	20 (1.0)	24 (1.2)	<0.001
Medications on admission				
Oral corticosteroids	27 (1.3)	12 (0.6)	15 (0.7)	0.01
VKA	87 (4.3)	67 (3.3)	20 (1.0)	<0.001
Risk scores				
Padua prediction score low risk (<4 points)	1583 (78.7)	201 (10.0)	1382 (68.7)	<0.001
Padua prediction score high risk (≥4 points)	428 (21.3)	167 (8.3)	261 (13.0)	<0.001
Caprini VTE risk assessment score low risk (1–2 points)	322 (16.3)	7 (0.3)	315 (16.0)	<0.001
Caprini VTE risk assessment score medium risk (3–4 points)	795 (39.5)	52 (2.6)	743 (36.9)	<0.001
Caprini VTE risk assessment score high risk (≥5 points)	888 (44.2)	299 (15.4)	589 (28.8)	<0.001
Death	7 (0.3)	2 (0.1)	5 (0.2)	0.62

Data was shown as number (percentage). VKA – oral anticoagulant therapy; BMI – body mass index; [1] asthma, chronic obstructive pulmonary disease and bronchiectasis; [2] idiopathic pulmonary fibrosis, sarcoidosis, nonspecific interstitial pneumonia, and hypersensitivity pneumonitis.

were in the same group of patients underusing thromboprophylaxis (Table 2).

Underuse of thromboprophylaxis in hospitalized patients was also observed in patients with pneumonia. As many as 203 (22.86%) of them scored 5 points or more using the Caprini VTE risk assessment, and were identified as at a high risk for VTE. A total of 144 (24.87%) individuals were identified to underuse thromboprophylaxis (Table 3). Using the Padua prediction score, 27 (10.34%) patients were demonstrated to underuse thromboprophylaxis (Table 2).

Among respiratory failure patients, as few as 10 (1.73%) individuals were identified to underuse thromboprophylaxis according to the Caprini VTE risk assessment (Table 3). Using the Padua prediction score, none of them was demonstrated to underuse thromboprophylaxis (Table 2).

Using the Padua prediction score, the overuse of thromboprophylaxis was common in the following groups based

Table 2. Use of thromboprophylaxis according to Padua prediction score

Variable	Patients who should receive thromboprophylaxis according to Padua prediction score ≥ 4 points	Patients who should not receive thromboprophylaxis according to Padua prediction score < 4 points	Patients who received thrombo-prophylaxis	Patients who did not receive thrombo-prophylaxis despite indication	Patients who received thrombo-prophylaxis without indication	p-value
Padua prediction score ≥ 4 points	428 (21.28)	1583 (78.7)	167 (39.01)	261 (60.98)	201 (9.99)	<0.001
Main cause of hospitalization						
Airways diseases[1]	14 (3.27)	318 (20.09)	2 (13.17)	12 (4.60)	63 (31.34)	<0.001
Lung cancer	359 (83.88)	192 (50.03)	141 (84.43)	218 (83.52)	19 (9.45)	<0.001
Interstitial lung disease	3 (0.70)	265 (16.74)	0 (0.00)	3 (1.15)	11 (5.47)	0.0006
Respiratory failure	0 (0.00)	28 (1.77)	0 (0.00)	0 (0.00)	9 (4.48)	<0.001
Pneumonia	41 (9.58)	739 (46.68)	14 (8.38)	27 (10.34)	63 (31.34)	<0.001
Pulmonary embolism	11 (2.57)	41 (2.59)	10 (5.99)	1 (0.38)	36 (17.91)	<0.001
Components of Padua prediction score						
Active cancer	419 (97.89)	68 (4.29)	160 (95.81)	259 (99.23)	7 (3.48)	<0.001
Previous VTE	9 (2.10)	4 (0.25)	7 (4.19)	2 (0.77)	1 (0.50)	0.0071
Advanced age (>70 years)	173 (40.42)	459 (29.00)	67 (40.12)	106 (40.61)	110 (54.73)	0.0035
Heart or respiratory failure	5 (1.17)	9 (0.57)	5 (2.99)	0 (0.0)	5 (2.49)	0.0253
Acute infection and/or rheumatic disease	367 (85.75)	599 (37.84)	149 (89.22)	218 (83.52)	140 (69.65)	<0.001
BMI > 30 kg/m^2	75 (17.52)	274 (17.31)	36 (21.56)	39 (14.94)	41 (20.40)	0.1562
Hormonal treatment	17 (3.97)	10 (0.63)	10 (5.99)	7 (2.68)	2 (0.99)	0.0189
Thrombophilia	1 (0.23)	1 (0.06)	1 (0.60)	0 (0.00)	1 (0.05)	0.4837

[1] Asthma, chronic obstructive pulmonary disease and bronchiectasis.

on the main causes of hospitalization: diseases of airways (n = 63; 31.34%); pneumonia (n = 63; 31.34%); and pulmonary embolism (n = 36; 17.91%) (Table 2). Using the Caprini VTE risk assessment, the overuse of thromboprophylaxis was common in patients with diseases of airways (n = 17; 28.81%), pulmonary embolism (n = 15; 25.42%), and pneumonia (n = 18; 30.51%) (Table 3).

Underuse of thromboprophylaxis was identified in some components of the Padua prediction score: active cancer (99.23%); acute infection or rheumatic disease (83.52%); and advanced age (40.61%) (Table 2). Taking into account the components of the Caprini VTE risk assessment and underuse of thromboprophylaxis, we observed among the patient groups: abnormal pulmonary function (99.65%); serious lung diseases (75.24%); and BMI > 25 kg/m^2 (63.73%) (Table 3).

Discussion

To our knowledge, this study is the largest analysis of the current everyday practice in thromboprophylaxis in patients hospitalized for pulmonary diseases. Given the rising prevalence of several pulmonary diseases in the general population, e.g., COPD, the significant risk for VTE during a hospital stay should also be acknowledged in this subset of medical patients. The current guidelines make it possible to choose 1 of a few validated scoring system to evaluate the VTE risk; however, using 2 of the tested scores, namely the Padua prediction score and Caprini VTE risk assessment, the proportion of patients with pulmonary disease who are deprived of benefits from the prophylactic use of LMWH is substantial. This observation indicates that every patient hospitalized for medical reasons should be assessed as a potential candidate for thromboprophylaxis.

There was a large subset of patients with pulmonary diseases hospitalized, i.e., 60.98% according to the Padua prediction score and 65.20% according to the Caprini VTE risk assessment, who did not receive proper prophylaxis of VTE. A much lower proportion of patients hospitalized for pulmonary disorders, i.e., 9.99% based on the Padua prediction score and 5.25% based on the Caprini VTE risk assessment, received prophylaxis of VTE, but did not need it according to the current recommendations. Compared to the 2007 ENDORSE study, the proportion of pulmonary patients without thromboprophylaxis during a hospital stay is comparable to the data obtained in non-surgical wards.[29] Our findings highlight the need for widespread use of thromboprophylaxis in medical patients, including those from pulmonary wards. The proportion of patients on thromboprophylaxis during a hospital stay is still suboptimal, and without significant improvement after about 10 years.

We identified some subsets of patients with pulmonary disorders who are more likely not to receive

Table 3. Use of thromboprophylaxis according to Caprini VTE risk assessment

Variable	Patients who should receive thrombo-prophylaxis according to Caprini VTE risk assessment ≥ 5 points	Patients who should not receive thrombo-prophylaxis according to Caprini VTE risk assessment < 5 points	Patients who received thrombo-prophylaxis	Patients who did not receive thrombo-prophylaxis despite indication	Patients who received thrombo-prophylaxis without indication	p-value
Caprini VTE risk assessment ≥ 5 points	888 (44.16)	1123 (55.88)	309 (34.79)	579 (65.20)	59 (5.25)	<0.001
Main cause of hospitalization						
Airways diseases[1]	138 (15.54)	194 (17.27)	48 (15.53)	90 (15.54)	17 (28.81)	0.028
Lung cancer	449 (50.56)	102 (9.08)	156 (50.48)	293 (50.60)	4 (6.78)	<0.001
Interstitial lung disease	47 (5.29)	221 (19.68)	9 (2.91)	38 (6.56)	2 (3.39)	0.052
Respiratory failure	16 (1.80)	12 (1.07)	6 (1.94)	10 (1.73)	3 (5.08)	0.214
Pneumonia	203 (22.86)	577 (51.38)	59 (19.09)	144 (24.87)	18 (30.51)	0.061
Pulmonary embolism	35 (39.77)	17 (1.51)	31 (10.03)	4 (0.69)	15 (25.42)	<0.001
Components of Caprini VTE risk assessment						
Age 41–60 years	93 (10.47)	396 (35.26)	28 (9.06)	65 (11.23)	18 (30.51)	<0.001
Age 61–75 years	431 (48.53)	434 (38.65)	146 (47.25)	285 (49.22)	27 (45.76)	0.7848
Age > 75 years	357 (40.20)	50 (4.45)	127 (41.10)	230 (39.72)	2 (3.39)	<0.001
History of VTE	10 (1.13)	1 (0.09)	8 (2.59)	2 (0.35)	0 (0.00)	0.0056
Varicose veins	127 (14.30)	37 (3.29)	61 (19.74)	66 (11.40)	7 (11.86)	0.0027
Congestive heart failure	12 (1.35)	2 (0.18)	10 (3.24)	2 (0.35)	0 (0.00)	0.0008
Swollen legs	76 (8.56)	17 (1.51)	64 (20.71)	12 (2.07)	7 (11.86)	<0.001
Serious lung diseases	682 (76.80)	299 (26.62)	262 (84.79)	420 (72.54)	32 (54.24)	<0.001
Abnormal pulmonary function	885 (99.66)	1078 (95.99)	308 (99.68)	577 (99.65)	59 (100.00)	0.9035
Cancer	475 (51.46)	12 (1.07)	166 (53.72)	309 (53.37)	1 (1.69)	<0.001
Thrombophilia	2 (0.22)	0 (0.00)	2 (0.65)	0 (0.00)	0 (0.00)	0.1263
BMI > 25 kg/m^2	587 (66.10)	478 (42.56)	218 (70.55)	369 (63.73)	20 (33.90)	<0.001

[1] Asthma, chronic obstructive pulmonary disease and bronchiectasis.

thromboprophylaxis during a hospital stay. It is disturbing to demonstrate that more than 50% of lung cancer patients did not receive thromboprophylaxis despite clear indications. Approximately 3% of lung cancer patients develop VTE within 2 years of diagnosis and this complication is associated with a 50% higher risk of death within 2 years.[23,24] These findings strongly support the need for much more common use of thromboprophylaxis in cancer patients.

The issue of prophylaxis in pulmonary embolism (PE) patients deserves a comment. Most of patients with PE, including incidental pulmonary embolism, received thromboprophylaxis in spite of being at a low risk for VTE (36 patients at a low risk for VTE according to the Padua prediction score, and 15 individuals according to the Caprini VTE risk assessment). It seems that this observation results from better implementation of the recommendations for PE treatment in the pulmonary ward. Obviously, patients with confirmed PE were treated, as recommended, mostly with therapeutic doses of LMWH during the hospital stay.

This study has several limitations. The study is retrospective, which implies some problems with data acquisition and their precision. We did not have data from other years to compare the trends in thromboprophylaxis in our hospital. In some patients, the diagnosis could have been not convincingly established and, for example, we could not address the issue as to whether asthma was associated with a comparable risk of VTE vs COPD. We did not assess the impact of certain comorbidities and high-risk VTE factors, e.g., recent myocardial infraction, stroke, injury or surgery, since none of the enrolled patients experienced such disease states. An analysis of the clinical outcomes of under- or overuse of thromboprophylaxis during a hospital stay and follow-up was beyond the scope of the current study.

From the practical point of view, it is important to put more focus on a proper assessment of patients at a high risk for VTE, and consistently use 1 assessment model to identify patients at a high risk for VTE. We believe that since at the John Paul II Hospital the Caprini VTE risk assessment was implemented as a preferred tool for assessing the patients' risk of VTE during hospitalization, the proportion of patients who can benefit from LMWH has been improving, also leading to better clinical outcomes among patients treated for pulmonary diseases.

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